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THE RELATION BETWEEN SIMPLE FEBRILE CONVULSION AND SERUM ZINC LEVEL IN CHILDREN

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ABSTRACT

Background: Febrile seizures are the most common seizures of childhood, aged between 6 months to 5 years. Pathophysiology of febrile seizure remains unknown, but reduction in serum and cerebrospinal fluid zinc levels, and low gamma-amino butyric acid (GABA) levels are thought to play a role in the pathogenesis of febrile seizure occurrence or recurrence. **Objective:** To find out the serum zinc level in children with simple febrile convulsion , and its relationship with age, sex, duration of fever and the causes of febrile illness. **Patients and methods:** A case-control study was performed on 90 children aged between six months to five years presented at emergency department of Child Central Teaching Hospital over a period of 4 months (from 15 November 2015 to 15 February 2016). Forty five patients had simple febrile seizure which is single attack of generalized convulsion with fever (temperature ≥38°C) occurring once time within 24 hours (as case group) and 45 patients were presented with acute febrile illness without convulsion in same degrees of temperature (as control group). A venous blood samples were obtained from both groups for determination of serum zinc level using colorimetric test kit and measured by Spectrophotometer. **Results:** A total of 90 patients were included, 45 patients were had febrile convulsion (28 males & 17 females), While the other 45 one had febrile illness with no fit (21 males and 24 females). The Mean temperatures of children in cases and control groups were (39.4±0.4°C & 38.9±0.4°C), respectively. The serum zinc level was low in 28 patients (62.2%) of febrile convulsion group, while only 14 patients (31.1%) of control group had low serum zinc level. Mean serum zinc level was 64.8±4 µg/dl , 74.18±14.9 µg/dl in cases and control group respectively which was significant statically (p<0.001). No significant relationship was observed between serum zinc level and age; patients had low serum zinc level in those aged below one year, 1-3 years & 3-5years, respectively with almost similar distribution in the control group] (p=0.795). Also no significant relationship between serum zinc level and sex among patients in febrile convulsion group and control one (M:F ratio 1.5:1 & 1.25:1 respectively, p=0.738). There was significant positive correlation between duration of fever before the attack and low serum zinc level in febrile convulsion patients. A higher percent of patients with low serum zinc level (78.2%) was seen in cases got longer duration of fever (more than 24 hr) before the fit, while only(45.4%) of patients who got fit in the 1st24 hours of the start of fever(p=0.023). So also the percentage of patients with low serum zinc level was higher in those with febrile convulsion for the first time as compared to patients with recurrent ones (p=0.03) which was statistically significant. No correlation between causes of fever with & low serum zinc level in both groups except gastro-enteritis cause which had high frequency of fit in low serum zinc [14 of patients got GE; 6 of them got low serum zinc level: 5 (83.3%) got fit & 1 (16.6%) had no fit], It is statistically Significant (p=0.001) that might relate to other race elements. **Conclusion:** Serum zinc level is lower in patients with febrile convulsion and no specific age group or gender is particularly predisposed to develop hypozincemia. Low serum zinc level is more obvious when the fever last more than 24 hours before occurrence of fit and it may play a role in the 1st attack of febrile convulsion. Only gastro-enteritis found to have significant association with low serum zinc level.

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INTRODUCTION

Febrile seizures (FS) or febrile convulsions (F.C) are the most common seizures of childhood, occurring in 2 to 5 % of children six months to five years of age (Febrile seizures, 2008). It is associated with fever (temperature≥38□) without any central nervous system (CNS) infection, electrolyte imbalance, metabolic disorders or a history of a febrile seizures. FS has a multifactorial inheritance suggesting that both genetic and environmental factors are causative (Chung, 2014). Febrile convulsions (F.C) are generally have benign nature, however they remain serious condition currently due to the recurrence rate seen in some cases and the slight risk of developing epileptic attacks (John, 2013). FS has more incidence in male than females, with seasonal variation mainly in winter & end of summer (John, 2013). FS can be divided into two categories; either simple or complex. Simple febrile seizure (SFS) is defined as generalized convulsion, lasting less than 15 minutes, comprised of generalized tonic and clonic activity without a focal component and without recurrence within 24 hours, while complex or complicated FS is defined as exhibiting one or more of the following features: partial onset or focal feature, prolonged duration of more than 15 minutes and recurrent febrile seizure within 24 hr of the episode (Chung, 2014).

So there are 3 critical components in definition of F.C

Age: **FS** are age-specific occurrences, with most episodes occurring when children are between the ages of 6 months and 5 years (Millar, 2006).

Fever: By definition there has to be a febrile illness or certainly fever. Many febrile seizures occur early in the illness (Waruiru, 2004). In some studies citing >38°C and others, >38.4°C. It is possible that the peak of the fever may be related to recurrent FS. Children with FS with a relatively low fever (<38.9°C) tend to present with an initial seizure that has focal features or is repeated within the same febrile illness (French, 2012).

Seizure: The vast majority of FSs are convulsions, usually tonic-clonic attack; less common symptoms include eye rolling, rigid limbs, or twitching. A simple febrile seizure stops by itself within few seconds to 10 minutes, mostly. It is often followed by a brief period of drowsiness or confusion. A seizure that lasts longer than 15 minutes, in just one part of the body, or occurs again during the same illness is not a simple febrile seizure (Mikati, 2011).

Pathophysiology: Although the mechanism of FS remains unclear, elevated brain temperature alters many neuronal functions, including several temperature-sensitive ion channels (Kimia, 2009), the fever-promoting pyrogen interleukin-1β which increase neuronal excitability, acting via both glutamate and gamma-aminobutyric acid (GABA) (Oluwabusi, 2012). hyperthermia-induced hyperventilation and alkalosis have been provokes neuronal excitability and contributes to seizure pathophysiology (JAMES, 2006). Hypozincemia has been suggested as a possible change during the rising phase of body temperature in patients (Ehsani, 2006). These results suggest that infection leads to hypozincemia through endogenous pyrogenic substances [16]. In addition, maternal smoking and alcohol consumption during pregnancy (Udani, 2005), iron deficiency& role of trace elements *like selenium, magnesium and copper* have been described in association with febrile seizures [18]. Genetic predisposition, with possible polygenic inheritance, has been identified as a cause. An autosomal dominant inheritance pattern, where possible mutations have been found in genes encoding the sodium channel, has been identified in a small number of families. The genetic contribution to the incidence of febrile seizures is manifested by a positive family history for febrile seizures in many patients .Males generally have a higher incidence, with a male to female ratio of around 2:1 (Kaputu-Kalala-Malu, 2004). Among first-degree relatives of children with febrile seizures, up to 30% had history of febrile seizures. Other siblings of an affected family have a 20-30% risk of having febrile seizures. In addition, monozygotic twins have a much higher concordance rate than dizygotic twins.

Risk factor of febrile seizures: (Udani, 2005). In an effort to predict which child is at a risk of febrile seizures, three risk factors have been identified:

- Febrile seizures in first or second degree relative.
- Parental report of developmental delay.
- Day care attendance, with two of these risk factors, the probability of a child developing febrile seizures is approximately 30%.

Zinc (Zn) is one of the essential minerals that plays a main role in treatment and prevention of neurological diseases (Khajeh, 2016 and Arcasoy, 2001), a lot of Studies have shown that iron, zinc, magnesium, selenium and copper are highly effective in febrile seizures (Srinivasa, 2014). Zinc is an important micronutrient that plays a significant role in growth and development, immune system response, enzymatic activity of different organs, proteins and cellular metabolism, neurological functions, nerve impulse transmission and hormone release (Sreenivasa, 2015). In addition, Zinc is known to play a control role in the immune system, and zinc deficient persons experience increased susceptibility to a variety of pathogens. Zinc also functions as an antioxidant and can stabilize membranes. Zinc significantly reduces severity of illness and the duration of fever in children with pneumonia and diarrhea by the activation of immune enhancing T-cells (Rabbani, 2013).

Dietary sources: *Meat, shellfish, whole grains, legumes& cheeses.*

Major Causes of Zinc Deficiency (Yanagisawa, 2002).

- Inadequate intake: Low-zinc-containing diets as prolonged intravenous alimentation.
- Malabsorption: Congenital acrodermatitis enteropathica, ingestion of absorption inhibitors, malabsorption syndrome as liver disease & drugs like chelating agents ex EDTA and penicillamine.
- Excessive loss as Loss into digestive fluid Increased urinary elimination, Burns, hemodialysis.
- Increased demand as in neonate.

Zinc deficiency contributes to an increased incidence and severity of diarrhea and associated with many psychological disorders as depression (Yanagisawa, 2002). Skin lesion at mucocutaneous junctions (mouth, eyes, anus, etc.) to the periphery, bullous or pustular dermatitis, erosive eczema, hyperkeratosis & skin atrophy (Acrodermetitis enteropathica)

[25]. Anorexia, growth retardation, delayed wound healing, dementia, disturbed dark adaptation (night blindness), gonadal hypofunction, glucose tolerance, increased carcinogenesis, increased incidence of cataracts &Abnormal pregnancy (Yanagisawa, 2002).

Treatment of (FS): Most often the FS has already ended spontaneously by the time a child is brought to a physician. In the rare event that the child is brought to the physician within 15 min and is still convulsing, intravenous (IV) diazepam (0.2-0.5 mg/kg) or rectal diazepam (0.5 mg/kg) should be given, and it is effective in stopping the seizure within 5 min. The child should be positioned in the left lateral position with chin up to maintain airway and allow drainage of secretions or vomitus. Nasal oxygen via a face mask should be given if the child is cyanosed (Joshi, 2014). Recently a newer benzodiazepine, midazolam (0.15 mg/kg intramascular or 0.1 mg/kg intravenous), has been found to be as effective as diazepam in stopping an FS, with the added advantage of quicker cessation and lesser risk of apnea (The Status Epilepticus Working Party, 2000). Children should be evaluated after an initial seizure and should focus on determining the source of the fever. Parents should be questioned about a family history of FS or epilepsy, immunizations, recent antibiotic use, duration of the seizure, a prolonged postictal phase and any focal symptoms. During the examination, attention should be given to the presence of meningeal signs and to the child's level of consciousness (Shinnar, 2008).

Several laboratory studies need to be considered in evaluating the patient with febrile seizure: Blood studies (serum electrolytes as sodium, potassium, calcium, phosphorus, magnesium, random blood sugar & complet blood count. A lumbar puncture is now an option when evaluating children six to 12 months of age whose immunization status for *Haemophilus influenzae* type b and *S. Pneumoniae* is incomplete or unknown, and in those pretreated with antibiotics. This differs from the previous recommendation that LP be performed in all children younger than 12 months and strongly considered in those 12 to 18 months of age with meningeal signs (Karande, 2007).

The two clear-cut indications for doing LP in a child with an FS include:

(i) complex FS (focal, prolonged or multiple),
(ii) clinical; history and examination being highly suggestive of occult meningitis.

There is no consistent evidence that routine EEG and/or abnormal EEGs after the first FS are predictive of either the risk of recurrence of FS or of the development of epilepsy. If the child is presenting with the first simple febrile seizure and is otherwise neurologically healthy, an EEG need not usually be performed as part of the evaluation. An EEG would not predict the future recurrence of febrile seizures or epilepsy even if the result is abnormal. If an EEG is indicated, it is delayed until or repeated after more than 2 weeks have passed [8]. Routine neuroimaging (CT scan or MRI) after simple FS is discouraged. Electroencephalography and neuroimaging may be considered in children with neurologic abnormalities on examination and in those with recurrent febrile seizure (Hampers, 2011).

Prophylaxis of recurrent febrile covultion

For therapy at time of fever, adequate fluid intake should be maintained to prevent dehydration. Paracetamol and ibuprofen are the two most common antipyretics used in the management of fever in children, and should be given in pediatric dosages to relieve discomfort secondary to fever but is not recommended for ongoing FS or for prevention of recurrent FSs (French, 2012 and Oluwabusi, 2012). The most widely accepted regimen when the choice for prophylactic treatment is made is intermittent therapy with benzodiazepines. This class of drugs is inexpensive, associated with good compliance, and provide excellent outcomes in terms of seizure prevention (Siqueira, 2010). Parent teaching should focus on the benign nature of the condition, mentioning the possibility of recurrence and the slight increase in risk of developing epilepsy, but always stressing the importance of letting the child lead a normal life. Measures that should be taught include protecting the child from physical trauma during the seizure, not allowing the insertion of any objects into the child's mouth, preventing aspiration in the post-ictal period, and monitoring seizure duration (Siqueira, 2010).

Prognosis: Simple febrile seizures may slightly increase the risk of developing epilepsy, but have no adverse effects on behavior, scholastic performance, or neurocognition.

Aim of study

- To find out S. Zn level in children with SFS and to compare their level with its level in children acute febrile illness without seizure.
- To determine if there is any relation between age, sex , duration of fever and the type of illness with low S. Zn level as acause of FS.

PATIENTS AND METHODS

A prospective case-control study was performed in Child Central Teaching Hospital in Baghdad city/Iraq; over a period of 4 months (from 15 November 2015 to 15 February 2016). This study was achieved on 90 children (Case group & Control group) aged between six months to five years at emergency department of Child Central Teaching Hospital. Forty five patients were presented with febrile convulsion (as case group) & 45 patients were presented with acute febrile illness without convulsion (as control group) in same degrees of temperature. All patients in the case group represented *simple febrile seizure which is a single attack of generalized convulsion with fever* (temperature ≥38□) *occurring once time within 24 hours*. [2]. A questionnaire was used to record information about the patients name, age, sex, temperature at time of admission, causes of fever, occurrance of convulsion or not, type of convulsion and duration; patients Hx of previous F.C & recurrence ; Family Hx of F.C or epilepsy ; Hx of recent vaccination, Hx of chronic diarrhea & chronic disease. Then a full physical examination for all patients was performed including weight & Height/length and other parts of the body to find out the cause of fever and/or convulsion. Temperature was recorded via axillary route by mercury glass thermometer bulb high in dry armpit for 3_4 min. All information about the children were taken after fully explaining the study procedure to the family. A blood sample was taken to determine causes of fever and exclude other causes of convulsion. Investigations included: - WBC, RBS, S. electrolyte (S. Na, S.K, S.Ca),

Table 1. Demographic distribution of patients in both of the studied groups

Variables	Febrile convulsion	Febrile with no fit
Gender	No.=45	No.=45
Male	28	21
Female	17	24
Variables	Mean ±SD	Mean ±SD
Temp.at admission(C)	39.4 ±0.4	38.9 ±0.4
Age	22.64 ±1.1	28.66 ±1.4
	No.=45	No.=45
6mon-1y	6	10
1y-3y	33	19
3-5y	6	16

Table 2. Comparison of average serum Zinc levels of patients between the study groups (case & control)

Variable	Total No. of patients	Patients with low s. zinc & (%)	S.Zn level (µg/dl) Mean ± SD	P-value
Patients with Febrile Fit	45	28(62.2)	64.8±4	<0.001
Patients Febrile with no Fit	45	14(31.1)	74.2±14.9	

Table 3. Distribution of patients in case & control group with Low Serum Zinc level in different age group

Age(Years)	No. of Pt. with febrile Fit	No. of Pt. with Febrile fit & low Zn.&(%)	No. of febrile Pt. with no fit	No. of febrile Pt. with no Fit & Low S.Zn.& (%)	P-value
0.5-1	6	4 (60)	10	3 (33.3)	0.795
1-3	33	21 (60)	19	7 (36.8)	
3-5	6	3 (50)	16	4 (42.5)	
Total	45	28 (62.2)	45	14 (31.1)	

Table 4. The relation between patients &low S. Zinc level & gender in case & control groups

Gender	No. of Pt. with Febrile fit	No. of Pt. with Febrile Fit & low S. Zn. & (%)	No. of Pt. febrile with no fit	No. of Pt. febrile with no fit& low S. Zn. & (%)	p-value
Male	28	17 (60.7)	21	8 (38)	0.738
Female	17	11 (64.7)	24	6 (25)	
Total	45	28 (62.2)	45	14 (31.1)	

Table 5. Patients with low Serum Zinc level in febrile convulsion group in relation to duration of fever before Fit

Duration of fever	Febrile Fit No. of cases	Febrile fit with low Zn. No of cases	Percentage %	P-value
< 24 h	22	10	45.4	0.023
>24 h	23	18	78.2	
Total	45	28	62.2	

Blood C/S, in addition to S. zinc (which was the goal of our study). Also GUE and CSF examination (if indicated). The blood samples were obtained under aseptic condition, 4-5 ml blood was taken for all Ix. All Patient with complex or atypical febrile convulsion, afebrile convulsion; epilepsy, central nervous system (CNS) infections, developmental delay and/or neurologic deficit, chronic diseases, Failure to thrive (FTT), chronic diarrhea, electrolyte imbalance & those on zinc therapy were excluded from this study. For determination of S.zinc level 1.5 ml of blood was Collected in biochemical tube (gel & plain) tube then the sample was centrifuged for 4_5 minutes at 3000-4000 rpm then serum obtained was collected in plain tube and stored at -20°C till the time of assay. Method was using colorimetric test kit and measured by Spectrophotometer UV/VIS **OPTIMA** with thermostatation, of wavelength 578 nm. Normal values of serum zinc level were defined from 70–120 µg/dl in pediatric age group (5 m to 6 year).

RESULTS

A total of 90 patients were included in this study, 45 patients of them were had FS and represented as case group in which 28 patients were males & 17 were females, While the other 45 patients had febrile illness with no fit (control group), 21 children of them were males and 24 children were females. The mean age of patients in the febrile seizure (case) and febrile illness groups (control) were 22.64±1.1 mon. and 28.66±1.4.mon, respectively. Age was ranged from 6 mon. - 5 years. They were categorized into 3 categories; in FS group 6 patients were below one year, 33 between 1-3 y & 6 aged 3 – 5 y. While in control group 10 patient were under one year, 19 one between 1-3 y& 16 children from 3-5 y.(as shown in table 3.1). The mean temperature of children in febrile seizure and febrile illness were (39.4±0.4℃ & 38.9±0.4℃), respectively. These also are shown in Table 1. The serum zinc level was low in 28 patients (62.2%) of F.C group, while only 14 patients (31.1%) of control group had low S. Zinc level. The mean S. zinc level in both group case & control groups was 64.8±4 & 74.18±14.9 respectively, which was statistically significantly lower in FS patients (case group) compared to control group (P <0.001). As shown in Table 2. Table 3: was represented age distribution in case & control groups with low S. Zinc level in different age groups. They were 4/6 (60%) , 21/33 (50%) & 3/6 (50%) patients with low S. Zinc level in those aged below one year, 1-3 years& 3-5years, respectively. An almost similar distribution was seen in control group {3/10 (33.3%), 7/19 (36.8%) & 4/16 (42.5%) at same age groups, respectively}.

Table 6. Correlation of recurrence of febrile fit attacks with low S. Zn. Level

No. of attacks	F.C	F.C. with low zinc	Percentage (%)	P-value
1st attack	30	22	73.33	0.03
Recurrent attack	15	6	40	
Total	45	28		

Table 7. Correlation between causes of fever and low S.zinc in both cases and control groups

Causes of fever	Total	Low zinc in both groups	Febril fit&low S.Zn.No.&(%)	Febril without fit&low S.Zn.No.(%)	p-value
O.M.	16	6	4(66)	2(33.3)	0.515
Tonsillitis	30	15	11(73.3)	4(26.6)	0.136
Pneumonia	15	8	4(50)	4(26.6)	0.125
GIT	14	6	5(83.3)	1(16.6)	0.001
UTI	15	5	4(80)	1(20)	0.067
Others	4	2	0	2(50)	0.046
Total	90	42	28(66.6)	14(33.3)	

There was no statistically significant difference (p=0.795) in both groups. In this study lower S. zinc level was show in 17 males and 11 females (M:F ratio 1.5:1) in case group while it was observed in 8 males & 6 female (M:F ratio 1.25:1) in the control group. That reported statistically not Significant difference in relation to gender (P value=0.789) as shown in Table 4. There was significant positive correlation between duration of fever before the attack of fit and low S. zinc level in F.C patients. A higher percent of patients with low S. Zinc level was seen in cases got longer duration of fever before the fit , more than 24 hr, [10/22 (45.4 %)] compared with those developed fit with fever duration less than 24 hr [18/23 (78.2%)] who got fever less than 24h, (p=0.023), all these was shown in Table 5. So also the percentage of patients with low S. Zinc was higher in those with febrile fit for the first time as compared to patient with recurrent febrile fit{22/30 (73.3%) vs. 6/15(40%)} (p=0.03) which was statistically significant. That is shown in Table 6. Table 7. represented the causes of fever in both case and control groups. 16 patients was found to have otitis media, 6 of them had low S. zinc level , 4 with convulsion & 2 had febrile with no fit. Tonsillitis was in 30 cases,15 of them got low S. Zinc level ,11 got fit& 4 fever without fit. Pneumonia was in 15 cases, 8 of them had low S. zinc level, 4 got fit & 4 had fever without fit. Gastroenteritis (GE) was in 14 of cases, 6 of them got low S. zinc, 5 got fit&1 had no fit. UTI was in 15 of cases, 5 of them got low S.zinc level,4 got fit& 1 without fit. The last 4 caese had other causes. No correlation between causes of fever with low S. zinc level in both groups and with occurrence of fit except in patients with GE which had high frequency of fit in low S. Zn. level it was statistically significant (p==0.001).

DISCUSSION

Zinc is one of the most abundant trace elements in the body, with high levels observed in human brains, and is required for cellular metabolism, cell differentiation, normal central nervous system development, neurologic functions, GABA receptor modulation, and nerve impulse transmission (Lee, 2012). Present study showed 28 (62.2%) patients with F.C, had low S. Zinc level while in control group there were 14 (31.1%) patients had low S. Zn level as the results of Ganesh R *et al* (Ganesh, 2011), *&* Vidyasagar V *et al* (Vidyasagar, 2015). Mean serum zinc level was significant lower in FC group than control group (64.8±4 vs. 74.18±14.9) µg/dl, (< *p* 0. 001). Amiri M et al. (Amiri, 2009) Modarresi MR et al. (Amiri, 2009), Lee J and Kim JH, (2012) and Talebian A et al (2009); all of them gave a comparable results, while *Park J et al* (2006), & Kafadar I et al, (Kafadar, 2012), did not support this hypothesis, they found that the differences of Zn serum levels between the case and control groups were not statistically significant, this may be due to their smaller sample size (both had control group & case group of 11 and 23 persons respectively). No observed gender significant difference in between the two group related to low S. Zinc level, which is comparable to several other international studies done on febrile convulsions and zinc level like Modarresi MR et al (2011), Mollah MA *et al.* (2002); comparing serum Zinc levels of febrile seizure children to their matched non seizure febrile peers. No effect of age on lowering the S. Zinc level in both cases and control group (p=0.795), which is comparable to other studies done on febrile convulsion cases and zinc level as Modarresi MR et al. (2011), Mollah MA et al (2002), Mahyar et al. (2010), Ganesh R *et al* (2011), Talebian *et al*. (2009) Kafadar *et al*. (2012), all these showed no statistically significant difference between the age of both groups & low S. zinc level. Results revealed the existence of statistically significant correlation between duration of fever before the attack of fit and low S. zinc level (p=0.023). It may be due to longer duration of infection associated with increased production of certain plasma proteins, cytokines (tumor necrosis factor, interleukin-1, interleukin-6) and interferon which may result in reduction of serum zinc level. This study was showed a high percentage of patients with low S. Zinc level in FC group had first time convulsion as compared to patients with recurrent FC, and was a statistically significant difference (p=0.03). It might be due to insufficient duration for follow up to confirm the diagnosis if it was F.C or other causes of convulsion trigger by zinc deficiency.

On the other hand the previous fits has not been observed and it could be not simple FC. Modarresi MR et al. reported that presence of hypozincemia in presence of other risk factors of febrile seizures may enhance the occurrence of febrile seizures explaining a possible correlation between low serum zinc levels and simple febrile seizures, while Nasehi MM et al. [39] gave the known role of genetic factors and a history of convulsion in the family as an etiology of FS and it is recommended that Zn should be prescribed for high-risk children, these explanations can assist understanding these results.. The study reported no statistically significant difference in both groups with low S. Zinc level and causes of fever as a contributing factor as a contributing factor to fit, (i.e no relation between causes of fever and low S. Zinc level in occurance of FS) that was similar to Foster M & Samman S, study (Foster, 2012) which represented that low S.zinc level is related to many types of infection, except for patients with GE

which represented one cause of fever that had a statistically significant difference (p>0.001). High frequency of fit with low S. zinc level in case group could be related to other trace elements that enhance the effect of low S. Zinc of F.C occurance, similar idea were observed in Nasehi MM et al. (Mahyar, 2010), which showed Zn is influenced by factors such as hemolysis, malnutrition, dehydration, fever, and infection which might be causes for this condition.

Conclusion

- Serum zinc level is lower in patients with simple febrile convulsion regardless their age and sex.
- Low S. zinc is more obvious when the fever last more than 24 hours before occurrence of fit.
- Low S. zinc may play a role in the 1st attack of febrile convulsion.
- Only gastro-enteritis was found to have significant association with low S. zinc level.

Recommendations

- We might think of giving Zn supplement in fever for high risk group of F.C.
- We need further longitudinal studies to find out possible helpful role of giving zinc supplement in patient with febrile convulsion to prevent recurrence.
- More emphasize on giving zinc supplement in patients with gastro-enteritis.

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